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(54) **METHOD AND APPARATUS FOR CONTROL OF GLOSS LEVEL IN PRINTED IMAGES**

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(52) **U.S. Cl.**
USPC **347/16**; 347/101; 347/104

(58) **Field of Classification Search**
USPC 347/9, 14, 16, 102–104, 99, 101, 179, 347/213
See application file for complete search history.

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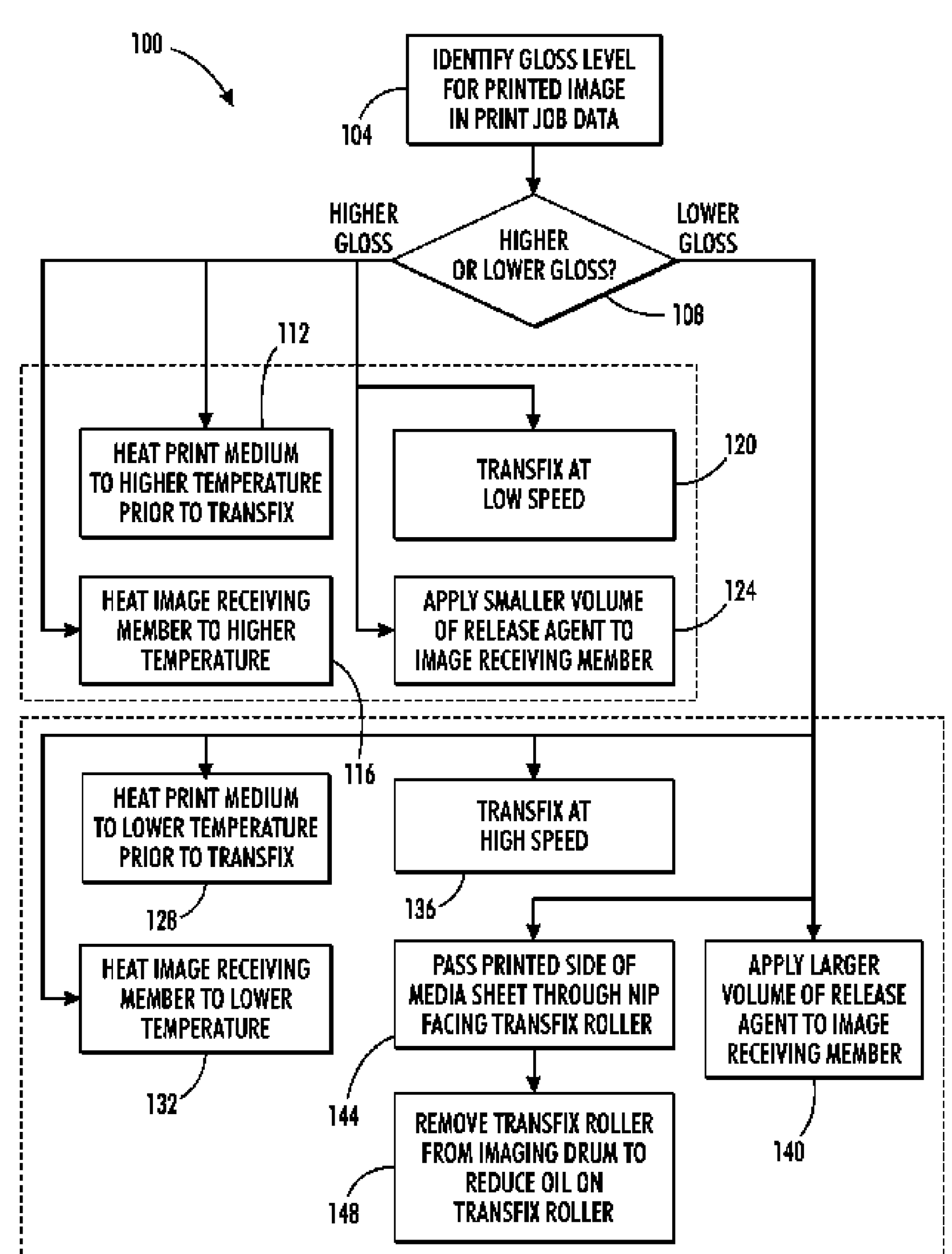
(57) **ABSTRACT**

An inkjet printer is configured to process print media having an ink image differently to alter a gloss level of the ink image on the print media. In one mode of operation, the printer moves print media bearing an ink image on one side only through a transfix nip a second time to reduce a gloss level of the printed image.

12 Claims, 4 Drawing Sheets



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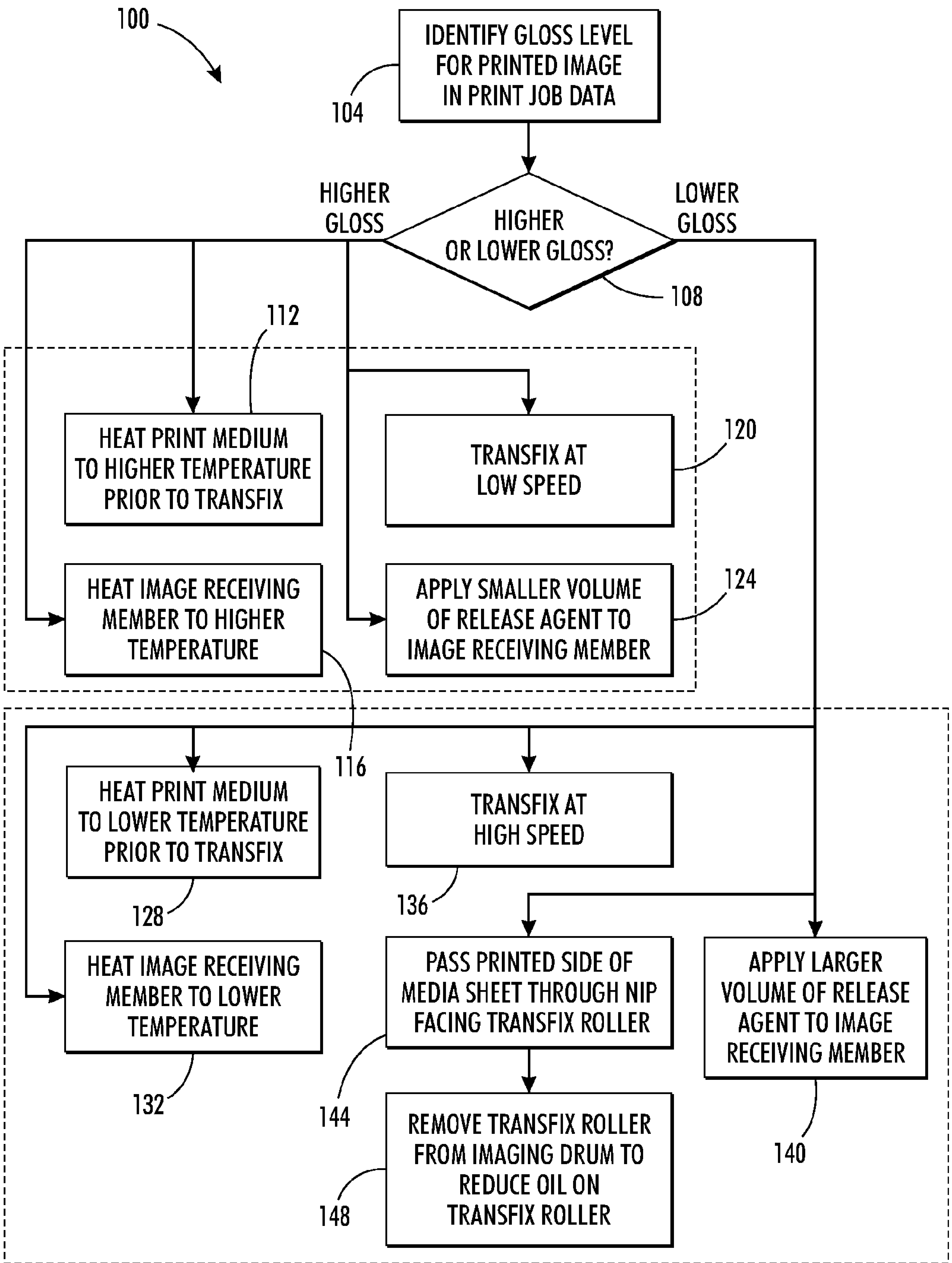

100
IDENTIFY GLOSS LEVEL FOR PRINTED IMAGE IN PRINT JOB DATA
104
HIGHER GLOSS
HIGHER OR LOWER GLOSS?
LOWER GLOSS
108
112
HEAT PRINT MEDIUM TO HIGHER TEMPERATURE PRIOR TO TRANSFIX
TRANSFIX AT LOW SPEED
120
HEAT IMAGE RECEIVING MEMBER TO HIGHER TEMPERATURE
APPLY SMALLER VOLUME OF RELEASE AGENT TO IMAGE RECEIVING MEMBER
124
116
HEAT PRINT MEDIUM TO LOWER TEMPERATURE PRIOR TO TRANSFIX
TRANSFIX AT HIGH SPEED
128
136
HEAT IMAGE RECEIVING MEMBER TO LOWER TEMPERATURE
PASS PRINTED SIDE OF MEDIA SHEET THROUGH NIP FACING TRANSFIX ROLLER
APPLY LARGER VOLUME OF RELEASE AGENT TO IMAGE RECEIVING MEMBER
132
144
REMOVE TRANSFIX ROLLER FROM IMAGING DRUM TO REDUCE OIL ON TRANSFIX ROLLER
140
148

FIG. 1

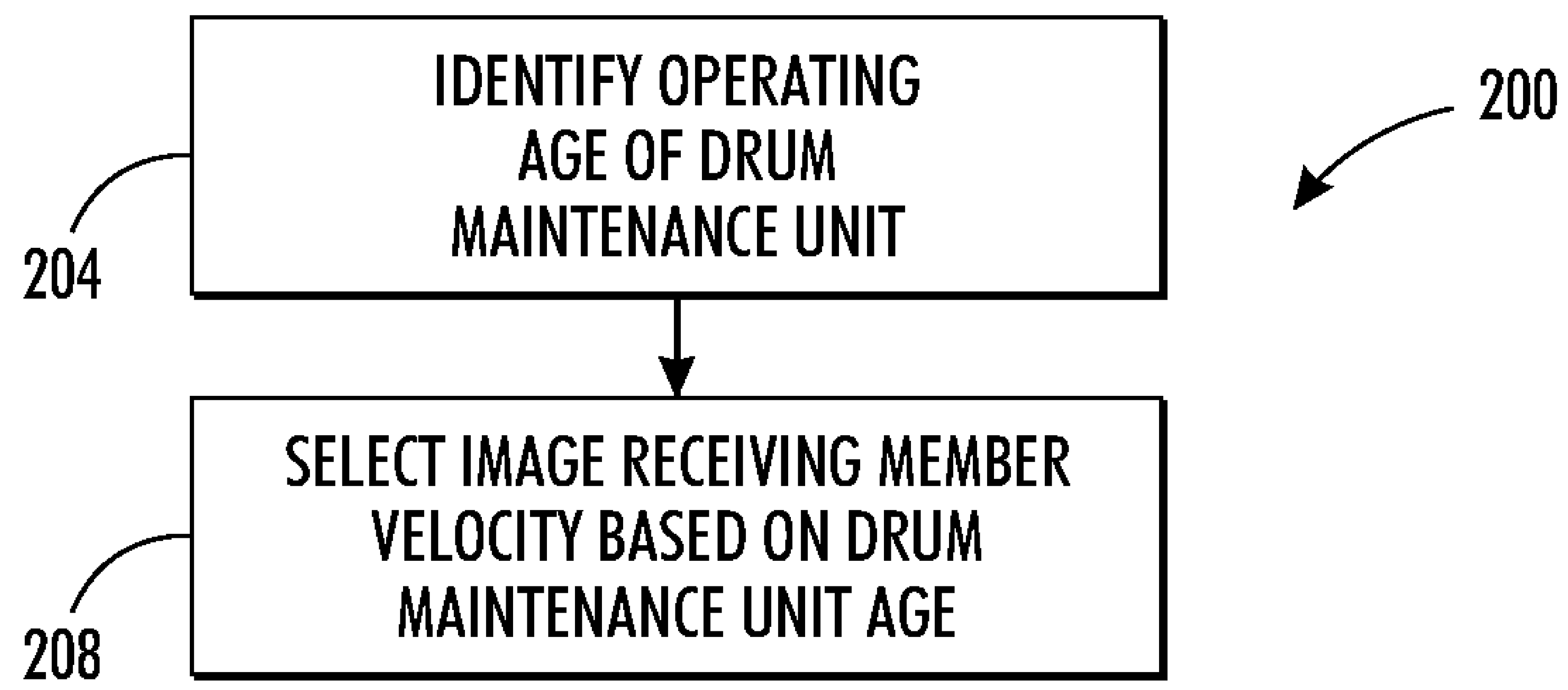

200
IDENTIFY OPERATING AGE OF DRUM MAINTENANCE UNIT
204
SELECT IMAGE RECEIVING MEMBER VELOCITY BASED ON DRUM MAINTENANCE UNIT AGE
208

FIG. 2

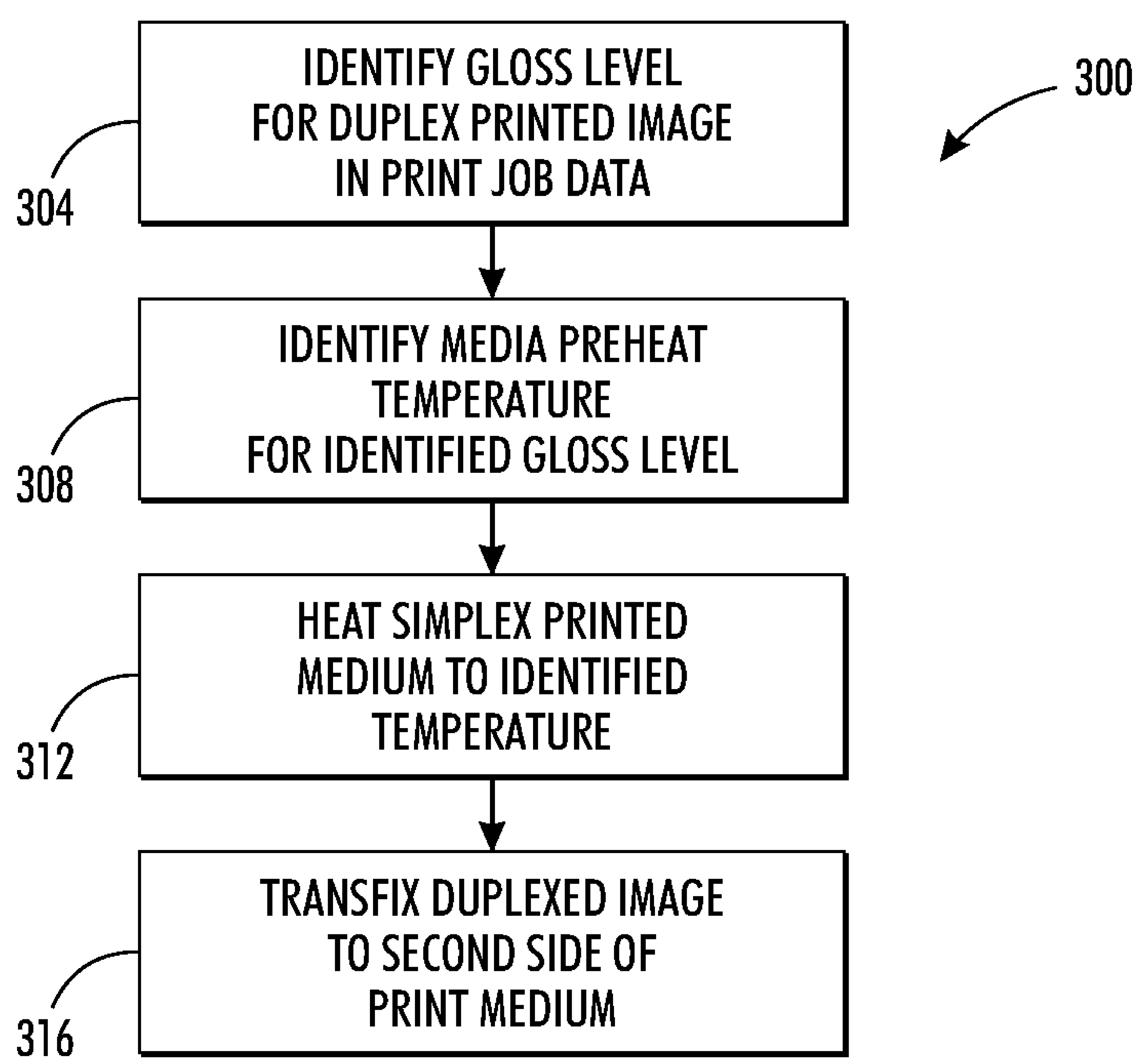
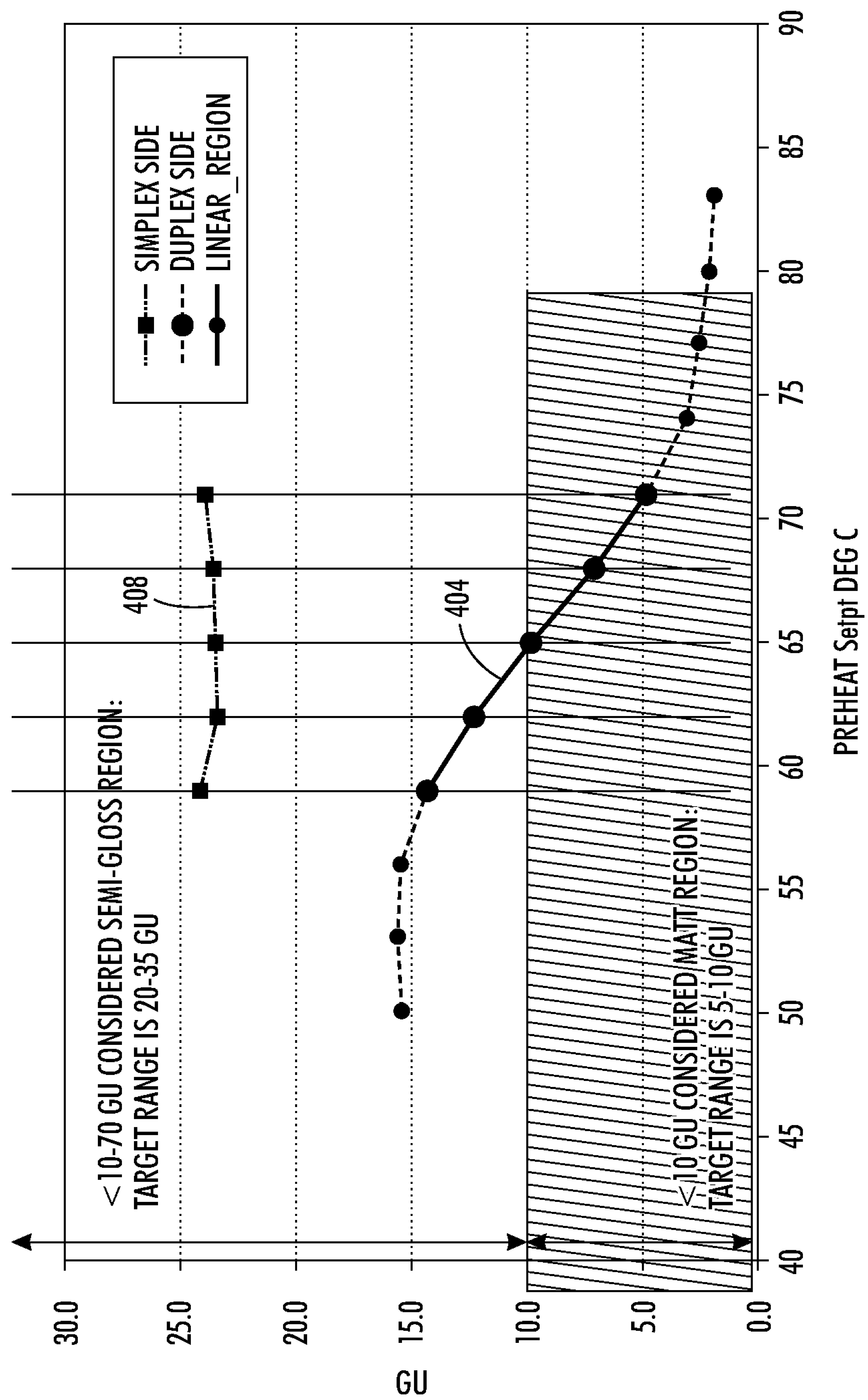

300
IDENTIFY GLOSS LEVEL FOR DUPLEX PRINTED IMAGE IN PRINT JOB DATA
304
IDENTIFY MEDIA PREHEAT TEMPERATURE FOR IDENTIFIED GLOSS LEVEL
308
HEAT SIMPLEX PRINTED MEDIUM TO IDENTIFIED TEMPERATURE
312
TRANSFIX DUPLEXED IMAGE TO SECOND SIDE OF PRINT MEDIUM
316

FIG. 3



<10-70 GU CONSIDERED SEMI-GLOSS REGION:
TARGET RANGE IS 20-35 GU
<10 GU CONSIDERED MATT REGION:
TARGET RANGE IS 5-10 GU
SIMPLEX SIDE
DUPLEX SIDE
LINEAR_REGION
408
404
GU
30.0
25.0
20.0
15.0
10.0
5.0
0.0
40
45
50
55
60
65
70
75
80
85
90
PREHEAT Setpt DEG C

FIG. 4

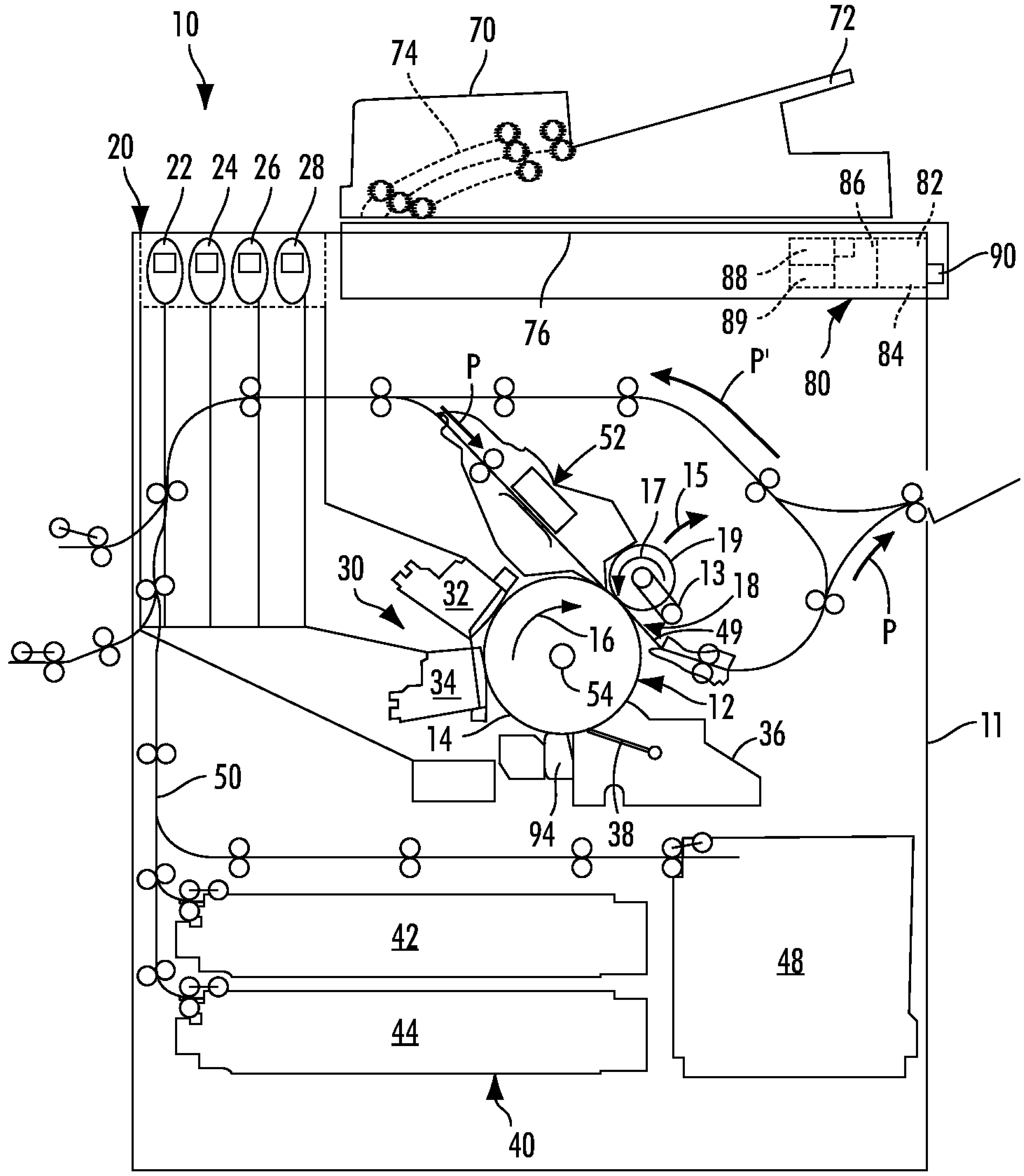


FIG. 5
PRIOR ART

METHOD AND APPARATUS FOR CONTROL OF GLOSS LEVEL IN PRINTED IMAGES

TECHNICAL FIELD

This document relates to inkjet printing, and, more specifically, to inkjet printers that control a gloss level of images formed during inkjet printing.

BACKGROUND

In general, inkjet printing machines or printers include at least one printhead that ejects drops or jets of liquid ink to produce an ink image on a recording or image forming media. A phase change inkjet printer employs phase change inks that are in the solid phase at ambient temperature, but transition to a liquid phase at an elevated temperature. Inkjets in one or more printheads eject the melted ink either directly onto a print medium or onto an intermediate imaging member and the image is transferred from the intermediate imaging member to the print medium. Once the ejected ink is on the print medium, the ink droplets quickly solidify to form a printed image.

One quality of a printed image is interchangeably referred to a "gloss," "gloss level," or the "glossiness" of the printed image. The glossiness of the printed image refers to how light is reflected from the surface of the printed image. In a printed image with a high gloss level, also referred to as a "glossy" image, a large portion of the light reflected from the printed image reflects in a specular manner. That is, a substantial portion of the light that reflects from the surface of the printed image reflects at an angle that is equivalent to the angle at which the incident light strikes the printed image. More plainly, a high gloss image has a more "mirror like" shine due to the specular reflection of light from the printed image. In a printed image with a low gloss level, also referred to as a "matte" image, a large portion of the light reflecting from the printed image reflects in a diffuse manner. In a diffuse reflection, reflected light leaves the printed image at many different angles instead of primarily reflecting at an angle equivalent to the incident angle of the light that strikes the printed image. More plainly, a matte image, which reflects light diffusely, appears to have less "shine" and can have a "softer" appearance compared to a glossy image.

Printed images with glossy and matte qualities are useful in a wide variety of printed documents. One known advantage of solid ink printers is that the composition of many solid inks produces ink images with a high gloss level without requiring specialized print media, such as glossy paper, and without requiring printer components that are specifically configured to add gloss to printed images. As noted above, however, many printed images are matte images that are produced with a low gloss level. Consequently, improvements to inkjet printers that enable production of printed images over a range of desired gloss levels would be beneficial.

SUMMARY

In one embodiment, a method for controlling a gloss level of a printed image has been developed. The method includes ejecting a plurality of ink drops onto a surface of an imaging member to form an ink image on the imaging member moving a print medium through a nip formed between the imaging member and a transfix member to transfer the ink image from the imaging member onto one side of the print medium, and moving the print medium through the nip after the ink image has been transferred to the print medium to reduce a gloss level of the printed image by engaging the one side of the print medium having the ink image with the transfix member while engaging another side of the print medium without an ink image.

In another embodiment, a method for controlling a gloss level of a duplex printed image has been developed. The method includes selecting an elevated temperature for heating a print medium, the elevated temperature being between a lower predetermined temperature and an upper predetermined temperature, the elevated temperature being selected with reference to a predetermined reduction in a gloss level for a second ink image to be transferred to a second side of the print medium, heating the print medium to the elevated temperature, the print medium having a first ink image formed on a first side of the print medium before the print medium is heated to the elevated temperature, and transferring the second ink image from an imaging member to the second side of the print medium after the print medium is heated to the elevated temperature to reduce the gloss level of the second ink image with the predetermined reduction in gloss level.

In another embodiment, a printer that is configured to control a gloss level of a printed image has been developed. The printer includes a plurality of inkjets configured to eject ink drops onto an imaging member, an actuator operatively connected to the imaging member to rotate the imaging member, a transfix member configured to move into and out of engagement with the imaging member to form a nip, a media path configured to move a print medium through the nip, and a controller operatively connected to the plurality of inkjets, the actuator, and the media path. The controller is configured to operate the actuator to rotate the imaging member, eject a plurality of ink drops onto the imaging member with the plurality of inkjets to form a first ink image on the imaging member, operate the media path to move the print medium through the nip to transfer the first ink image from the imaging member onto a first side of the print medium, and operate the media path to move the print medium through the nip to reduce a gloss level of the first ink image by engaging the first ink image with the transfix member and engaging a second side of the print medium having no ink image with the imaging member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a process **100** for operating an inkjet printer to generate printed images with a selected gloss level.

FIG. **2** is a block diagram of a process **200** for controlling a volume of release agent applied to an imaging member to control a gloss level of a printed image.

FIG. **3** is a block diagram of a process **300** for controlling a gloss level of a duplex printed image in an inkjet printer.

FIG. **4** is a graph depicting a relationship between a temperature of a print medium in a duplex print mode prior to printing a duplex ink image and a gloss level of ink formed in the duplex ink image.

FIG. **5** is a schematic view of a prior art inkjet printer.

DETAILED DESCRIPTION

For a general understanding of the present embodiments, reference is made to the drawings. In the drawings, like reference numerals have been used throughout to designate like elements.

As used herein, the term "printer" refers to a device that produces ink images on print media. "Print media" may be a physical sheet of paper, plastic, or other suitable physical print media substrate for images, whether precut or continuous media fed. The printer can include a variety of other components, such as finishers, paper feeders, and the like, and may be embodied as a copier, printer, or a multifunction machine. A "print job" or "document" is normally a set of related sheets, usually one or more collated copy sets copied from a set of original print job sheets or electronic document page images, from a particular user, or otherwise related. An image generally includes information in electronic form which is to be rendered into data used to generate signals that operate inkjet ejectors to form an ink image on an image receiving surface and can include text, graphics, pictures, and the like. As used herein, the process direction is the direction in which an image receiving surface, e.g., media sheet or media, or intermediate transfer drum or belt, moves as an ink image is formed on the image receiving surface in the printer. The cross-process direction, along the same plane as the image receiving surface, is substantially perpendicular to the process direction. As used herein, the terms "simplex" and "duplex" refer to print modes that print ink images on a single side or on both sides, respectively, of a two sided print medium.

As used herein, the term "transfixing" refers to an operation in an indirect inkjet printer whereby an ink image formed from a plurality of ink drops is transferred from an intermediate imaging member to a print medium. The transfixing operation transfers the ink drops to one side of the print medium and simultaneously applies heat, pressure, or a combination thereof to permanently fix the ink image to the media sheet.

As used herein, the term "gloss level" refers to a propensity of a printed ink image to reflect light in a specular manner. With a high gloss level, the ink image reflects light in a more specular manner. With a low gloss level, the ink image reflects light in a more diffuse manner. An inkjet printer can produce ink images with a wide range of gloss levels based on the propensity of the ink image to reflect light in a specular or diffuse manner. The term "gloss unit" refers to a numeric scale for measuring the gloss level of an ink image. The gloss level of the ink image is proportional to the number of gloss units measured for light that is reflected from the ink image. For illustrative purposes, this document refers to numeric gloss units (GUs) that are defined in the ASTM D2457 standard entitled "Standard Test Method for Specular Gloss of Plastic Films and Solid Plastics," and published by ASTM International.

FIG. **5** depicts a prior art indirect inkjet printer **10** that is configured to adjust the gloss level of printed ink images. FIG. **5** depicts an embodiment of a prior art printer **10** that can be configured to print ink images with different gloss levels. As illustrated, the printer **10** includes a frame **11** to which is mounted directly or indirectly all its operating subsystems and components, as described below. The phase change ink printer **10** includes an imaging member **12** that is shown in the form of a rotatable imaging drum, but can equally be in the form of a supported endless belt. The imaging member **12** has an image receiving surface **14**, which provides a surface for formation of ink images. A heater **54** in the imaging member **12** generates heat to elevate the temperature of the image receiving surface **14** during imaging operations. The imaging member heater **54** is configured with an adjustable output to heat the image receiving surface **14** to a selected temperature. An actuator **94**, such as a servo or electric motor, engages the imaging member **12** and is configured to rotate the imaging member **12** in direction **16**. In the printer **10**, the actuator **94** varies the rotational rate of the imaging member **12** during different printer operations including maintenance operations, image formation operations, and transfixing operations. A transfix roller **19** rotatable in the direction **17** loads against the surface **14** of drum **12** to form a transfix nip **18** within which ink images formed on the surface **14** are transfixed onto a heated print medium **49**. A transfix roller position actuator **13** is configured to move the transfix roller **19** into the position depicted in FIG. **5** to form the transfix nip **18**, and to move the transfix roller **19** in direction **15** to disengage the transfix nip **18** and imaging member **12**.

The phase change ink printer **10** also includes a phase change ink delivery subsystem **20** that has multiple sources of different color phase change inks in solid form. Since the phase change ink printer **10** is a multicolor printer, the ink delivery subsystem **20** includes four (4) sources **22**, **24**, **26**, **28**, representing four (4) different colors CMYK (cyan, magenta, yellow, and black) of phase change inks. The phase change ink delivery subsystem also includes a melting and control apparatus (not shown) for melting or phase changing the solid form of the phase change ink into a liquid form. Each of the ink sources **22**, **24**, **26**, and **28** includes a reservoir used to supply the melted ink to the printhead assemblies **32** and **34**. In the example of FIG. **5**, both of the printhead assemblies **32** and **34** receive the melted CMYK ink from the ink sources **22-28**. In another embodiment, the printhead assemblies **32** and **34** are each configured to print a subset of the CMYK ink colors. Alternative printer configurations print a single color of ink or print a different combination of ink colors.

The phase change ink printer **10** includes an imaging drum maintenance unit **36**. The maintenance unit includes a reservoir holding a liquid release agent, such as silicone oil, and includes a metering blade **38**. The maintenance unit **36** applies a layer of the release agent on the image receiving surface **14** of the rotating imaging member **12** prior to operation of the printhead assemblies **32** and **34** to form ink images on the imaging member **12**. The metering blade **38** regulates the volume of release agent on the image receiving surface **14** to form a uniform layer of the release agent for carrying ink drops. The release agent forms a barrier between the image receiving surface **14** and the ink drops in the latent ink image to prevent the ink drops from adhering to the imaging member **12** instead of being transfixed to a print medium.

The phase change ink printer **10** includes a substrate supply and handling subsystem **40**. The substrate supply and handling subsystem **40**, for example, includes sheet or substrate supply sources **42**, **44**, **48**, of which supply source **48**, for example, is a high capacity paper supply or feeder for storing and supplying image receiving substrates in the form of a cut sheet print medium **49**. The phase change ink printer **10** as shown also includes an original document feeder **70** that has a document holding tray **72**, document sheet feeding and retrieval devices **74**, and a document exposure and scanning subsystem **76**. A media transport path **50** extracts print media, such as individually cut media sheets, from the substrate supply and handling system **40** and moves the print media in a process direction P. The media transport path **50** passes the print medium **49** through a substrate heater or pre-heater assembly **52**, which heats the print medium **49** prior to transfixing an ink image to the print medium **49** in the transfix nip **18**.

One or both of the media transport **50** and the pre-heater assembly **52** are configured to heat the print medium **49** to one of a range of temperatures before the print medium **49** passes through the transfix nip **18**. In one configuration, the thermal output of the pre-heater assembly is adjusted to raise or lower the temperature of the print medium **49**. In another configuration, the media transport **50** adjusts the speed of the print medium **49** as the print medium **49** moves past the pre-heater assembly **52** in the process direction P. The increase in temperature of the print medium **49** as the print medium moves past the pre-heater assembly **52** is related to the thermal output of the pre-heater assembly **52** and inversely related to the speed of the media transport **50**.

Media sources **42**, **44**, **48** provide image receiving substrates that pass through media transport path **50** to arrive at transfix nip **18** formed between the imaging member **12** and transfix roller **19** in timed registration with the ink image formed on the image receiving surface **14**. As the ink image and media travel through the nip, the ink image is transferred from the surface **14** and fixedly fused to the print medium **49** within the transfix nip **18** in a transfix operation. In a duplexed configuration, the media transport path **50** passes the print medium **49** through the transfix nip **18** a second time for transfixing of a second ink image to a second side of the print medium **49**. In the printer **10**, the media path **50** moves the print medium in a duplex process direction P' and returns the print medium **49** to the transfix nip with the first side of the print medium **49** carrying the first ink image engaging the transfix roller **19** and the second side of the print medium **49** engaging the imaging member **12**. If a second ink image is formed on the image receiving surface **14**, then the second ink image is transfixed to the second side of the print medium in a duplex print operation.

Operation and control of the various subsystems, components and functions of the printer **10** are performed with the aid of a controller or electronic subsystem (ESS) **80**. The ESS or controller **80**, for example, is a self-contained, dedicated minicomputer having a central processor unit (CPU) **82** with a digital memory **84**, and a display or user interface (UI) **86**. The ESS or controller **80**, for example, includes a sensor input and control circuit **88** as well as an ink drop placement and control circuit **89**. In one embodiment, the ink drop placement control circuit **89** is implemented as a field programmable gate array (FPGA). In addition, the CPU **82** reads, captures, prepares and manages the image data and print job parameters associated with print jobs received from image input sources, such as the scanning system **76**, or an online or a work station connection **90**. As such, the ESS or controller **80** is the main multi-tasking processor for operating and controlling all of the other printer subsystems and functions.

The controller **80** can be implemented with general or specialized programmable processors that execute programmed instructions, for example, printhead operation. The instructions and data required to perform the programmed functions are stored in the memory **84** that is associated with the processors or controllers. The processors, their memories, and interface circuitry configure the printer **10** to form ink images, and, more particularly, to control the operation of inkjets in the printhead modules **32** and **34** to form ink images, and to control the operations of the printer components and subsystems described herein for controlling the gloss level of printed images. The components in the controller **80** are provided on a printed circuit card or provided as a circuit in an application specific integrated circuit (ASIC). Each of the circuits can be implemented with a separate processor or multiple circuits are implemented on the same processor. In alternative configurations, the circuits are implemented with discrete components or circuits provided in very large scale integration (VLSI) circuits. Also, the circuits described herein can be implemented with a combination of processors, FPGAs, ASICs, or discrete components.

In operation, the printer **10** ejects a plurality of ink drops from inkjets in the printhead assemblies **32** and **34** onto the surface **14** of the imaging member **12**. The controller **80** generates electrical firing signals to operate individual inkjets in one or both of the printhead assemblies **32** and **34**. In the multi-color printer **10**, the controller **80** processes digital image data corresponding to one or more printed pages in a print job, and the controller **80** generates two dimensional bit maps for each color of ink in the image, such as the CMYK colors.

The printer **10** is an illustrative embodiment of a printer that adjusts the gloss level of printed images using the processes described herein, but the processes described herein can adjust the gloss levels of printed images in alternative inkjet printer configurations. Additionally, while printer **10** is an indirect printer, printers that eject ink drops directly onto a print medium can be operated using the processes described herein.

FIG. **1** depicts a process **100** for selecting a gloss level of a printed image in an inkjet printer. In the discussion below, a reference to the process **100** performing a function or action refers to a controller executing programmed instructions stored in a memory to operate one or more components of the printer to perform the function or action. Process **100** is described in conjunction with the printer **10** for illustrative purposes. In the printer **10** the controller **80** executes programmed instructions stored in the memory **84** to process print job data and control the subsystems in the printer **10** to generate printed images with different gloss levels.

Process **100** begins by identifying a gloss level for a printed image in print job data (block **104**). In the printer **10**, the print job data include one or more parameters that specify a desired gloss level of a printed image. The print job data can include a parameter that specifies a numeric gloss level for the printed image, or the printer **10** can identify a gloss level indirectly with reference to one or more print job parameters. In one configuration, if print job data indicate that an ink image is predominantly black and white text, then the printer **10** identifies a low gloss level associated with the text, while the printer **10** identifies a high gloss level if the print job data indicate the image is a full color photograph.

In process **100**, the printer **10** adjusts the operation of one or more components during the printing operation to generate an ink image with the identified gloss level. A number of individual operations generate ink images with increased or decreased gloss levels. The operations described below can be performed individually or in combination to generate ink images with a desired gloss level. Additionally, the process **100** can perform some operations that increase the gloss level of the printed image and other operations that decrease the gloss level of the printed image to generate ink images with a range of intermediate gloss levels.

Based on the identified gloss level, process **100** can generate printed images with a high gloss level (block **108**). In the printer **10**, process **100** generates ink images with increased gloss levels by heating the print medium **49** to a higher temperature prior to transfixing the ink image (block **112**), heating the imaging member to a higher temperature (block **116**), transfixing the ink image to the media sheet at a low speed (block **120**), and applying a comparatively smaller volume of release agent to the imaging member during a transfixing operation (block **124**).

In the processing described with reference to block **112**, the printer **10** activates the pre-heater assembly **52** to heat the print medium **49** to an elevated temperature before the print medium **49** passes through the transfix nip **18**. The elevated temperature of the print medium enables phase-change ink that is transfixed from the imaging member **12** onto the print medium **49** to remain liquid for a longer time. The elevated temperature enables the liquid ink to spread and form a more uniform surface that reflects light in a specular manner, resulting in an increased gloss level of the printed image. In the embodiment of printer **10**, the elevated temperature of the print medium is approximately 65° C.

In the processing described with reference to block **116**, the printer **10** activates the imaging member heater **54** to heat the image receiving surface **14** to an elevated temperature prior to forming an ink image on the image receiving surface **14**. The elevated temperature of the imaging member **12** also elevates the temperature of liquid ink drops that are ejected onto the image receiving surface **14**. The higher temperature ink drops spread more evenly on the print medium **49** during the transfix process and form a more uniform surface that reflects light in a specular manner, resulting in an increased gloss level of the printed image. In the embodiment of printer **10**, the image receiving surface **14** is heated to approximately 58° C. in a high gloss print mode. Both the heating of the print medium **49** described above and the heating of the imaging receiving surface **14** enable the phase change ink to remain in a liquid phase for a longer period of time during and after the transfixing process to enable the liquid ink to solidify with a smoother surface and higher gloss level.

In the processing described with reference to block **120**, the printer **10** rotates the imaging member **12** at a lower rate as the print medium **49** passes through the transfix nip **18** to transfer the ink image onto the print medium **49** with a higher gloss level. In the printer **10**, the linear speed of the image receiving surface **14** is approximately 5 inches per second (IPS) as the print medium **49** passes through the transfix nip **18**. At a lower transfixing speed, the print medium **49** spends comparatively more time in the transfix nip **18**. The increased time in the transfix nip **18** enables the transfix roller **17** and the imaging member **12** to apply pressure and heat to the ink image on the print medium for a longer period of time, producing a smoother surface of the ink image that reflects light in a specular manner and has a higher gloss level.

In the processing described with reference to block **124**, the printer **10** applies a comparatively smaller volume of release agent to the image receiving surface **14**. The maintenance unit **36** applies release agent from an internal reservoir to the imaging member **12** to prevent ink drops from the printhead units **32** and **34** from adhering to the image receiving surface **14** instead of transferring to the print medium **49**. The metering blade **38** in the maintenance unit **36** engages the imaging member **12** to regulate the volume of release agent that is applied to the imaging drum. The metering blade **38** wipes excess release agent from the image receiving surface **14** to produce a uniform layer of release agent on the imaging member **12**.

Over the operating life of the maintenance unit **36**, the metering blade **38** experiences mechanical wear. The worn metering blade **38** removes less of the excess release agent from the image receiving surface **14** than a new metering blade. Consequently, the volume of oil that is transferred to the imaging member during each maintenance operation increases during the operational life of the maintenance unit **36**.

FIG. **2** depicts a process **200** for control of the printer **10** to compensate for wear on the metering blade **38** and control the volume of release agent that is applied to the image receiving surface **14**. In the discussion below, a reference to the process **200** performing a function or action refers to a controller executing programmed instructions stored in a memory to operate one or more components of the printer to perform the function or action. In the printer **10**, the controller **80** executes programmed instructions stored in the memory **84** to adjust the volume of release agent applied to the imaging member **12**. In process **200**, the printer **10** identifies the operating age of the drum maintenance unit (block **204**). In one embodiment, the controller **80** stores an operational age value of the maintenance unit **36** in the memory **84**. The controller **80** increments the operational age value with reference to an operating parameter of the imaging member or the maintenance unit such as the number of images printed or the number of times that the metering blade **38** engages the imaging member **12** during operation. If the maintenance unit **36** is replaced, the controller **80** resets the operational age value and monitor the operational age of the new maintenance unit.

The printer **10** controls the volume of release agent that is applied to the imaging member **12** by adjusting a rotational velocity of the imaging member **12** when the maintenance system **36** applies release agent to the imaging member **12** with reference to the identified age of the metering blade **12** (block **208**). The volume of release agent that is applied to the imaging member **12** increases as the rotational velocity of the imaging member **12** increases. The controller **80** adjusts the rotational velocity of the imaging member to apply the release agent to the imaging member based on the identified gloss level of the printed image. In the printer **10**, the image receiving surface **14** moves at linear velocity of approximately 10 IPS in a high gloss operating mode for a new metering blade and gradually reduces the linear velocity of the image receiving surface to X IPS as the metering blade **38** wears during operation.

Referring again to FIG. **1**, process **100** can generate printed images with a lower gloss level (block **108**) based on the identified gloss level in the print job data. In the printer **10**, process **100** generates ink images with decreased gloss levels by heating the print medium **49** to a lower temperature prior to transfixing the ink image (block **128**), heating the imaging member to a lower temperature (block **132**), transfixing the ink image to the media sheet at a high speed (block **136**), applying a comparatively larger volume of release agent to the imaging member during a transfixing operation (block **140**), and by transferring the printed media page through the nip a second time to engage the transfix roller **19** to the printed image on the print medium **49** (block **144**).

In the processing of block **128**, the printer **10** activates the pre-heater assembly **52** to heat the print medium **49** to an elevated temperature before the print medium **49** passes through the transfix nip **18**. The heater **52** heats the print medium **49** to an elevated temperature that is less than the elevated temperature identified in the processing described with reference to block **112** above. The heater **52** heats the print medium **49** to a temperature that enables the ink image formed on the imaging member **12** to be transferred to the print medium **49**, and to have the phase change ink cool and solidify more quickly than in the high gloss level operating mode. The lower temperature enables the liquid ink to solidify with rougher surface that reflects light in a more diffuse manner, resulting in a decreased gloss level of the printed image. In the embodiment of printer **10**, the elevated temperature of the print medium is approximately 50° C.

In the processing described with reference to block **132**, the printer **10** activates the imaging member heater **54** to heat the image receiving surface **14** to an elevated temperature prior to forming an ink image on the image receiving surface **14**. The heater **52** heats the image receiving surface **14** to an elevated temperature that is lower than the elevated temperature identified in the processing described above with reference to block **116**. The image receiving surface **14** is heated to a temperature than enables the ink image to be transferred to the print medium with a reduced gloss level. The lower temperature ink drops spread to a lesser degree on the print medium **49** during the transfix process and form a less uniform surface that reflects light in a diffuse manner, resulting in a decreased gloss level of the printed image. In the embodiment of printer **10**, the image receiving surface **14** is heated to approximately 55° C. in a low gloss print mode. Both the heating of the print medium **49** described above and the heating of the imaging receiving surface **14** enable the phase change ink to cool and solidify in a shorter period of time during and after the transfixing process to produce a solid ink image with a rougher surface and lower gloss level.

In the processing described above with reference to block **136**, the printer **10** rotates the imaging member **12** at a higher rate as the print medium **49** passes through the transfix nip **18** to transfer the ink image onto the print medium **49** with a higher gloss level. In the printer **10**, the linear speed of the image receiving surface **14** is approximately 20 inches per second (IPS) as the print medium **49** passes through the transfix nip **18**. At a higher transfixing speed, the print medium **49** spends comparatively less time in the transfix nip **18**. The decreased time in the transfix nip **18** enables the ink image transferred from the image receiving surface **14** to transfer to the print medium **49** more quickly with less time to spread the ink drop on the print medium and producing a rougher surface on the ink image that reflects light in a diffuse manner for a lower gloss level.

In the processing described with reference to block **140**, the printer **10** applies a comparatively larger volume of release agent to the image receiving surface **14**. The printer **10** rotates the imaging member **12** at a rate that is greater than the rate identified in the processing described above with reference to block **124** and the maintenance unit **36** applies a greater volume of the release agent to the image receiving surface **14**. As described above with reference to process **200**, the controller **80** can adjust the rotational rate of the imaging member **12** with reference to the operational age of the maintenance unit **36** and metering blade **38** to apply a selected volume of release agent to the image receiving surface **14**. In the printer **10**, the image receiving surface **14** moves at a linear velocity of approximately 80 IPS to receive a greater volume of release agent from the maintenance unit **36**.

In the processing of block **144**, the print medium **49** moves through the duplex media path P' and returns to the transfix nip **18** after the ink image is transfixed to the first side of the print medium **49**. The duplex media path P' orients the printed side of the print medium **49** to engage the transfix roller **19** instead of the imaging member **12**. In a simplex print mode, the imaging member **12** does not transfer an ink image to the second side of the print medium **49**. The surface of the transfix roller **19** engages the printed ink image. In the printer the surface of the transfix roller is textured and the surface of the transfix roller **19** applies pressure to the ink image on the print medium **49** as the print medium **49** passes through the transfix nip **18**. The engagement with the transfix roller **19** increases the roughness and reduces the gloss level of the ink image.

As described above, the textured surface of the transfix roller **19** reduces the gloss level of the printed image. In the printer **10**, a portion of the transfer agent on the image receiving surface **14** can transfer to the transfix roller **19** when the imaging member **12** rotates while engaged to the transfix roller **19** prior to the print medium **49** entering the transfix nip **18**. When the transfix roller **19** subsequently engages the printed image on the printed medium **49**, the release agent on the transfix roller tends to reduce the effectiveness of the transfix roller **19** in reducing the gloss level of the printed image. For example, in the printer **10**, passing the printed side of a simplex printed sheet through the duplex media path P' and through the transfix nip generates a reduction of approximately 5 to 10 GUs when release agent covers the transfix roller.

Process **100** optionally removes the transfix roller **19** from engagement with the imaging drum when a print medium is not present in the transfix nip **18** to reduce or eliminate the transfer of release agent to the transfix roller **19** (block **148**). In the printer **10**, the transfix roller position actuator **13** moves the transfix roller in direction **15** to remove the transfix roller from engagement with the imaging member **12**. The imaging member **12** rotates in direction **16** to receive release agent from the maintenance unit **16** and to receive ink drops that form a latent ink image from the printhead units **32** and **34**. Once the latent ink images are formed on the image receiving surface **14**, the rotation of the imaging member **12** halts and the media path **50** moves a leading edge of the print medium **49** into a position between the transfix roller **19** and the imaging member **12**. The transfix roller position actuator **13** moves the transfix roller **19** into engagement with the imaging member **12** through the print medium **49**, which is already in the transfix nip **18**. The imaging member **12** resumes rotation in direction **16** to transfer the ink image to the print medium **49** and the movement of the imaging member **12** advances the print medium through the transfix nip **18** in the process direction P.

After the ink image is transfixed to the print medium **49** and prior to the print medium **49** exiting the nip, the imaging member **12** halts and the transfix roller position actuator **13** moves the transfix roller **190** out of engagement with the imaging member **12**. The printer **10** disengages the transfix roller **19** from the imaging member **12** in a similar manner when no print medium is present in the transfix nip **18**. Thus, the transfix roller **19** does not directly engage the image receiving surface **14** and release agent from the image receiving surface **14** does not transfer to the transfix roller. In a subsequent duplex pass, the bare transfix roller **19** engages the printed ink image on the first side of the media sheet and reduces the gloss level of the printed ink image by an additional 5 to 10 GU.

FIG. **3** depicts a process **300** for adjusting the gloss level of a duplex printed image. In a duplex print mode, a first ink image is printed on one side of a print medium and the printer subsequently forms a second ink image on the second side of the print medium. In the discussion below, a reference to the process **300** performing a function or action refers to a controller executing programmed instructions stored in a memory to operate one or more components of the printer to perform the function or action. Process **300** enables a printer to select a gloss level for the second ink image without substantially affecting the gloss level of the previously printed first ink image. In the printer **10** the controller **80** executes programmed instructions stored in the memory **84** to process print job data and control the subsystems in the printer **10** to generate duplex printed images with different gloss levels.

Process **300** begins by identifying a gloss level for the duplex printed image in the print job data (block **304**). As described above, the print job data can include a parameter that specifies a numeric gloss level for the printed image, or the printer **10** can identify a gloss level indirectly with reference to one or more print job parameters. In some print jobs, the gloss level identified in the print job data for the first ink image printed on a print medium **49** differs from the gloss level identified for the second ink image.

Once the gloss level for the duplex printed image is identified, process **300** identifies a temperature for heating the print medium **49** prior to transfixing the duplex image (block **308**). FIG. **4** depicts a graph **404** of the gloss level of duplex images over a range of temperatures for the print medium **49** and a graph **408** of the gloss level of simplex images on the print medium **49** during the duplex imaging operation. In the phase change printer **10**, the gloss level for the duplex ink image is inversely proportional to the temperature of the print medium in a twelve degree temperature range between approximately 58° C. and 70° C. The gloss level decreases approximately linearly from a maximum of 15 GU at 58° C. to a minimum of approximately 5 GU at 70° C. While the temperature of the print medium affects the gloss level of the duplex printed image, the simplex printed image, depicted in graph **408**, varies minimally with the selected temperature of the print medium. Consequently, process **300** identifies a temperature to heat the print medium with reference to the identified gloss level of the duplex image without substantially affecting the gloss level of previously printed simplex image.

Referring again to FIG. **3**, process **300** heats the print medium to the identified temperature (block **312**) and transfixes the duplex ink image onto the second side of the print medium (block **316**). In the printer **10**, the pre-heater assembly **52** heats the print medium **49** to the identified temperature as the print medium **49** approaches the transfix nip **18**. The media transport **50** moves the print medium **49** to the transfix nip **18**, and the duplex ink image is transfixed from the imaging member **12** to the second side of the print medium **49**.

The processes **100** and **300** described above can be used individually and in combination in various printer embodiments. For example, the printer **10** performs process **100** to control the gloss level of images formed during simplex imaging operations and during first-side printing in duplex imaging operations. The printer **10** also performs process **300** to control the gloss levels of second-side images formed during duplex printing operations. The printer **10** performs process **100** in combination with process **300** for duplex printed images to further adjust the gloss level of the duplex printed image. Alternative printer embodiments implement some or all of the foregoing operations to adjust the gloss level of printed images.

It will be appreciated that various of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems, applications or methods. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

What is claimed is:

1. A method of changing a gloss level of a printed image produced by a printer comprising:

operating a plurality of inkjets with a controller to eject a plurality of ink drops onto a surface of an imaging member to form an ink image on the imaging member;

operate a media path to move a print medium through a nip formed between the imaging member and a transfix member to transfer the ink image from the imaging member onto one side of the print medium; and

operate the media path to move the print medium through the nip after the ink image has been transferred to the print medium to reduce a gloss level of the printed image by engaging the one side of the print medium having the ink image with the transfix member while engaging another side of the print medium not having an ink image with the imaging member.

2. The method of claim **1**, the moving of the print medium with the media path by the controller to reduce the gloss level further comprising:

operating an actuator with the controller to separate the imaging member and the transfix member after transferring the ink image to the print medium and prior to the print medium moving through the nip to reduce the gloss level;

operating the actuator with the controller to move the transfix member to contact the imaging member to form the nip before moving the print medium through the nip to reduce the gloss level.

3. The method of claim **1** further comprising:

applying a first volume of a release agent or a second volume of the release agent to the imaging member with the controller prior to forming the ink image on the imaging member, the first volume being greater than the second volume, the first volume of release agent generating the printed image with a first gloss level and the second volume of release agent generating the printed image with a second gloss level, the first gloss level being less than the second gloss level.

4. The method of claim **3** wherein the controller operates the actuator to move the imaging member at a first rotational speed for application of the first volume of the release agent and at a second rotational speed for application of the second volume of the release agent, the first rotational speed being greater than the second rotational speed.

5. The method of claim **4** further comprising:

identifying with the controller an operational age of a maintenance unit that applies the release agent to the imaging member; and

operating the actuator with the controller to adjust the first rotational speed of the imaging member and the second rotational speed of the imaging member with reference to the identified operational age of the maintenance unit.

6. The method of claim **1** further comprising:

operating the actuator with the controller to move the imaging member at a first rotational speed or a second rotational speed when moving the print medium through the nip to transfer the ink image, the first rotational speed being greater than the second rotational speed, the first rotational speed generating the printed image with a first gloss level and the second rotational speed generating the printed image with a second gloss level, the first gloss level being less than the second gloss level.

7. The method of claim **1** further comprising:

operating a heater with the controller to heat the imaging member to a first temperature or a second temperature prior to moving the media sheet through the nip to transfer the ink image, the first temperature being greater than the second temperature, the first temperature generating the printed image with a first gloss level and the second temperature generating the printed image with a second gloss level, the first gloss level being greater than the second gloss level.

8. A printer comprising:

a plurality of inkjets configured to eject ink drops onto an imaging member;

an actuator operatively connected to the imaging member to rotate the imaging member;

a transfix member configured to move into and out of engagement with the imaging member to form a nip;

a media path configured to move a print medium through the nip; and

a controller operatively connected to the plurality of inkjets, the actuator, and the media path, the controller being configured to:

operate the actuator to rotate the imaging member;

eject a plurality of ink drops onto the imaging member with the plurality of inkjets to form an ink image on the imaging member;

operate the media path to move the print medium through the nip to transfer the ink image from the imaging member onto a first side of the print medium; and

operate the media path to move the print medium through the nip to to reduce a gloss level of the ink image by engaging the ink image with the transfix member and engaging a second side of the print medium having no ink image with the imaging member.

9. The printer of claim **8**, the controller being further configured to:

apply a first volume of a release agent or a second volume of the release agent to the imaging member prior to forming the ink image on the imaging member, the first volume being greater than the second volume, the first volume of release agent generating the printed image with a first gloss level and the second volume of release agent generating the printed image with a second gloss level, the first gloss level being less than the second gloss level.

10. The printer of claim **9**, the controller being further configured to:

operate the actuator to move the imaging member at a first rotational speed for application of the first volume of the release agent and to move the imaging member at a second rotational speed for application of the second volume of the release agent, the first rotational speed being greater than the second rotational speed.

11. The printer of claim **10**, the controller being further configured to:

identify an operational age of a maintenance unit that applies the release agent to the imaging member; and

operate the actuator to adjust the first rotational speed of the imaging member and the second rotational speed of the imaging member with reference to the identified operational age of the maintenance unit.

12. The printer of claim **8**, the controller being further configured to:

operate the actuator to move the imaging member at a first rotational speed or a second rotational speed when moving the print medium through the nip to transfer the ink image, the first rotational speed being greater than the second rotational speed, the first rotational speed generating the printed image with a first gloss level and the second rotational speed generating the printed image with a second gloss level, the first gloss level being less than the second gloss level.

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